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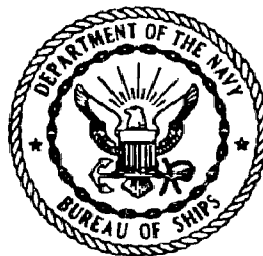
EFFECT OF SHELF AGING ON MIL-P-5516 O-RINGS
FIFTH PROGRESS REPORT

REPORT NO. 92-18

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RUBBER LABORATORY
MARE ISLAND NAVAL SHIPYARD



TECHNICAL REPORT

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EFFECT OF SHELF AGING ON MIL-P-5516 O-RINGS
FIFTH PROGRESS REPORT

REPORT NO. 92-18

Project No. S-F013-13-01

Task No. 907

RUBBER LABORATORY
MARE ISLAND NAVAL SHIPYARD
VALLEJO, CALIFORNIA

Prepared 24 February 1964

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ABSTRACT

O-rings originally conforming with Military Specification MIL-P-5516 and which had reached the maximum allowed storage age of 4 years, were tested after an additional 5 years of shelf aging. During the original 4 years the rings were sealed in lined envelopes, but during the ensuing 5 years, some rings were exposed to light and air, some were exposed to air with light excluded and some were kept sealed in the original envelopes.

No significant changes in physical properties from the standpoint of serviceability were observed after shelf aging for 5 additional years under the above conditions.

It is concluded that O-rings which meet the requirements of Specification MIL-P-5516 will give satisfactory service after at least 9 years shelf aging at moderate room temperatures.

REFERENCES

- (a) BUSHIPS ltr All/NSM-033-200(344) Ser 344-1021 of 15 Oct 1958
- (b) BUSHIPS ltr All/NSM-033-200(344) Ser 344-1045 of 7 Nov 1958
- (c) BUSHIPS ltr F-013-13-01 Ser 634C1-1419 of 19 Sep 1960
- (d) BUSHIPS ltr F-013-13-01 Ser 634C1-769 of 25 Jul 1961
- (e) Military Specification MIL-P-5516A of 15 Jan 1952; "Packings and Gaskets; Hydraulic, Aircraft"
- (f) Federal Test Methods Standard No. 601 of 12 Apr 1955; "Rubber; Sampling and Testing"
- (g) NAVSHIPYD MARE Rubber Laboratory Report No. 92-6 of 29 Feb 1960; "Effect of Shelf Aging on MIL-P-5516A O-Rings, Progress Report No. 1"
- (h) NAVSHIPYD MARE Rubber Laboratory Report No. 92-7 of 26 Jan 1961; "Effect of Shelf Aging on MIL-P-5516A, Progress Report No. 2"
- (i) NAVSHIPYD MARE Rubber Laboratory Report No. 92-9 of 8 Feb 1962; "Effect of Shelf Aging on MIL-P-5516A O-Rings, Progress Report No. 3"
- (j) NAVSHIPYD MARE Rubber Laboratory Report No. 92-15 of 29 Jan 1963; "Effect of Shelf Aging on MIL-P-5516A O-Rings, Fourth Progress Report"

INTRODUCTION

1. The Rubber Laboratory was requested by the Bureau of Ships in references (a), (b), (c) and (d) to determine the effects of shelf aging on the physical properties of O-rings forwarded as enclosures with references (a) and (b). The O-rings were Size AN6230-6, manufactured by the companies identified in Appendix 1 to conform with the requirements of Military Specification MIL-P-5516A, reference (e). When received by the Laboratory, the O-rings had already been in storage for a period of 4 years.
2. The Bureau of Ships, in reference (a), requested the Laboratory to test the O-rings upon receipt and yearly thereafter. The O-rings were to be shelf aged at 70 - 80°F under the following conditions:
 - a. Sealed in original, air-tight, lined, envelopes.
 - b. Removed from the envelopes and exposed to air and diffuse light from neon-filled tubes (light exposure approximately 10 hours of every working day).

- c. Removed from the envelopes and exposed to air with light excluded.

TEST PROCEDURES

3. To determine the effects of shelf aging, the properties listed below were measured on the rings as received and after five years aging under conditions outlined in paragraph 2. The temperature during the aging period was $73.5 \pm 2^\circ\text{F}$. Forty rings were used to determine the initial tensile properties and 20 rings were used to determine the aged tensile properties for each storage condition. Permanent set was measured on ten rings initially, and on five rings after aging under each storage condition.

- a. Tensile strength, ultimate elongation and tensile stress at 100% elongation were determined according to methods 4111, 4121 and 4131 respectively, of Federal Test Methods Standard No. 601, reference (f).
- b. Permanent set was measured according to Military Specification MIL-P-5516A, Class A, paragraph 4.5.2.4, reference (e).
- c. Specific gravity was measured according to Method 14011 of Federal Test Methods Standard No. 601.

RESULTS OF TESTS

4. The results of the tests performed on the O-rings when received (4 years after manufacture) and after 1, 2, 3, 4, and 5 years additional shelf aging are given in Appendix 2. The results of tests after 1, 2, 3, and 4 years, given in Reports 92-6, 92-7, 92-9 and 92-15, references (g), (h), (i), and (j), respectively, are repeated for comparison.

5. The data show that no changes in the measured physical properties have occurred during the 1, 2, 3, 4, or 5 additional years of shelf aging, which would significantly affect the serviceability of the O-rings. The greatest change observed

was in the stress at 100% elongation of the Code 2 rings stored exposed to air and light for 5 years in addition to the original 4 years; an increase of 22% was obtained. This change would not affect the serviceability of the O-rings.

CONCLUSIONS

6. From the results of this investigation it is concluded that O-rings originally meeting the requirements of Military Specification MIL-P-5516A will be satisfactory for service after shelf aging at moderate temperatures for at least 9 years.

FUTURE WORK

7. The shelf aging of the O-rings is being continued.

PERSONNEL

Tests performed by:

J. M. Holloway, Technologist

Report prepared by:

A. E. Barrett
A. E. Barrett, Supervisory Technologist

Approved by:

R. E. Morris
R. E. Morris, Head, Rubber Laboratory

APPENDICES

1. Table. Identification of manufacturers of O-rings.
2. Table. Effect of Shelf Aging for Nine Years on Properties of MIL-P-5516 O-Rings.

Distribution of report

Abstract Cards

EFFECT OF SHELF AGING FOR NINE YEARS ON PROPERTIES OF

1

Properties	After 4 yrs. shelf aging	After 5 yrs. shelf aging			After 6 yrs.		Code
	A*	A*	B*	C*	A	B	
Tensile strength, psi	1600	1590	1570	1560	1630	1570	1
Change in tensile strength, %		-0.6	-2	-3	+2	-2	+0.6
Ultimate elongation, %	140	150	150	140	140	140	140
Change in ultimate elongation, %		+7	+7	0	0	0	0
Tensile stress, 100% elongation, psi	1090	1020	1010	1050	1140	1090	1080
Change in tensile stress, %		-6	-7	-4	+5	0	-1
Permanent set, 50% elongation, %	2	1	1	1	1	1	1
Change in permanent set, %		-50	-50	-50	-50	-50	-50
Specific gravity	1.31	1.34	1.34	1.34	1.34	1.34	1.34
Change in specific gravity, %		+2	+2	+2	+2	+2	+2

Properties	A	A	B	C	A	B	C	Code
Tensile strength, psi	1730	1630	1770	1770	1760	1750	1740	1
Change in tensile strength, %		-6	+2	+2	+2	+1	+1	
Ultimate elongation, %	150	150	160	150	150	150	150	
Change in ultimate elongation, %		0	+7	0	0	0	0	
Tensile stress, 100% elongation, psi	980	960	1000	980	1010	1050	980	1
Change in tensile stress, %		-2	+2	0	+3	+7	0	
Permanent set, 50% elongation, %	1	1	1	1	1	1	1	
Change in permanent set, %		0	0	0	0	0	0	
Specific gravity	1.31	1.32	1.32	1.32	1.32	1.32	1.32	
Change in specific gravity, %		+1	+1	+1	+1	+1	+1	

*A - O-rings stored in sealed envelopes

B - O-rings exposed to air and artificial light

C - O-rings exposed to air but light excluded

NOTE: All aging beyond four years was performed in a constant temperature room maintained at 73.5° ± 2°F

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SHELF AGING FOR NINE YEARS ON PROPERTIES OF MIL-P-5516 O-RINGS

Code 1 O-Rings

shelf aging		After 6 yrs. shelf aging			After 7 yrs. shelf aging			After 8 yrs. shelf aging			After 9 yrs. shelf aging		
B*	C*	A	B	C	A	B	C	A	B	C	A	B	C
70	1560	1630	1570	1610	1550	1550	1580	1560	1590	1560	1550	1590	1620
-2	-3	+2	-2	+0.6	-3	-3	-1	-3	-0.6	-3	-3	-0.6	+1
50	140	140	140	140	130	130	140	140	130	140	140	140	140
+7	0	0	0	0	-7	-7	0	0	-7	0	0	0	0
10	1050	1140	1090	1080	1130	1150	1130	1110	1180	1080	1060	1160	1100
-7	-4	+5	0	-1	+4	+6	+4	+2	+8	-1	-3	+6	+2
1	1	1	1	1	1	1	1	1	1	1	1	1	1
50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50
1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.33	1.34	1.33	1.34	1.34	1.34
+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2	+2

Code 2 O-Rings

B	C	A	B	C	A	B	C	A	B	C	A	B	C
70	1770	1760	1750	1740	1750	1760	1760	1750	1770	1640	1710	1790	1560
+2	+2	+2	+1	+1	+1	+2	+2	+1	+2	-5	-1	+3	-10
60	150	150	150	150	150	140	150	150	160	160	140	140	160
+7	0	0	0	0	0	-7	0	0	+7	+7	-7	-7	+7
00	980	1010	1050	980	1110	1120	1090	1050	1080	850	1110	1200	870
+2	0	+3	+7	0	+13	+14	+11	+7	+10	-8	+13	+22	-11
1	1	1	1	1	1	1	1	1	1	1	1	1	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.32	1.32	1.32	1.32	1.32	1.31	1.32	1.31	1.31	1.31	1.31	1.32	1.32	1.32
+1	+1	+1	+1	+1	0	+1	0	0	0	0	+1	+1	+1

temperature room maintained at 73.5° ± 2°F

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